SITE INVESTIGATION PLAN
FOR THE
CARRIER AIR CONDITIONING CO.
COLLIERVILLE, TN

prepared by

Environmental and Safety Designs, Inc.
Memphis, TN
and
Dames & Moore
Cincinnati, OH

March 20, 1987

Project No: 1048-003

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1.0 INTRODUCTION

The following is a Plan for an environmental investigation of property occupied by Carrier Air Conditioning Company (Carrier) in Collierville, TN. The investigation will be conducted by Environmental & Safety Designs, Inc. (EnSafe), Memphis, TN, in association with Dames & Moore (D&M), Cincinnati, OH; and in coordination with the Tennessee Department of Health and Environment, Division of Superfund.

1.1 Site Description

The Carrier property consists of approximately 145 acres southwest of the intersection of Highway 57 and Byhalia Road in Collierville, TN. Figure 1 is a vicinity map for the facility. The property was farmland until 1967 when it became industrial with the construction of the Carrier manufacturing facility (then called Day & Night Company). Original topographic data, as well as original subsurface conditions, are available from site investigations performed in 1966 and 1967 to determine foundation construction conditions. However the facility has been expanded several times in the interim. In particular the area south and west of the manufacturing facility has undergone changes in use and topography since 1979. Figure 2 is a sketch of the property showing locations of current structures and existing monitoring wells.

Original topographic and drainage pattern data for the property have been obtained.

1.2 Potential Sites of Releases

The State of Tennessee, Department of Health and Environment (TDHE) issued a Site Inspection Report (SIR) on the Carrier property in Collierville on 15 September 1986 which stated that

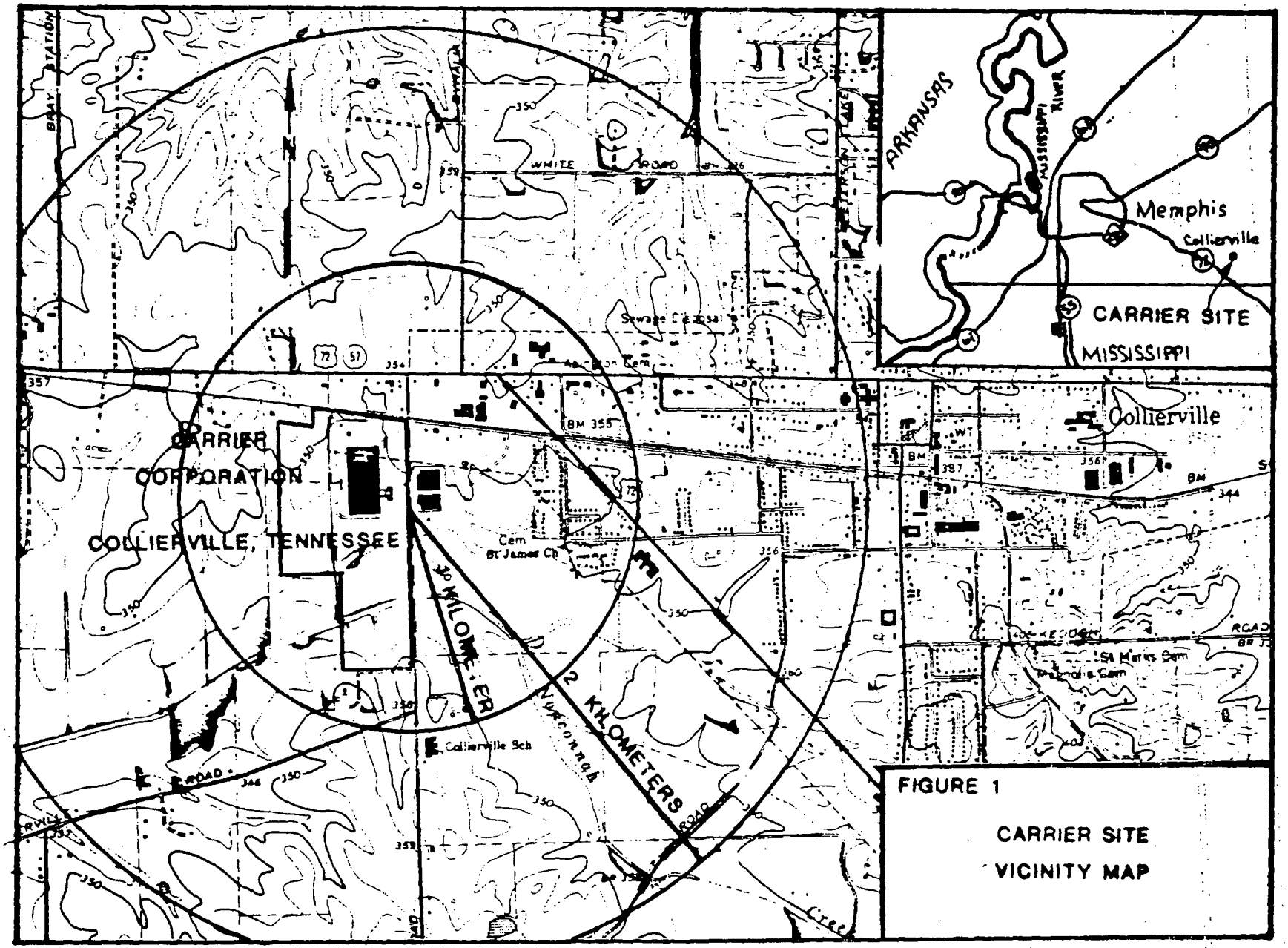


FIGURE 1

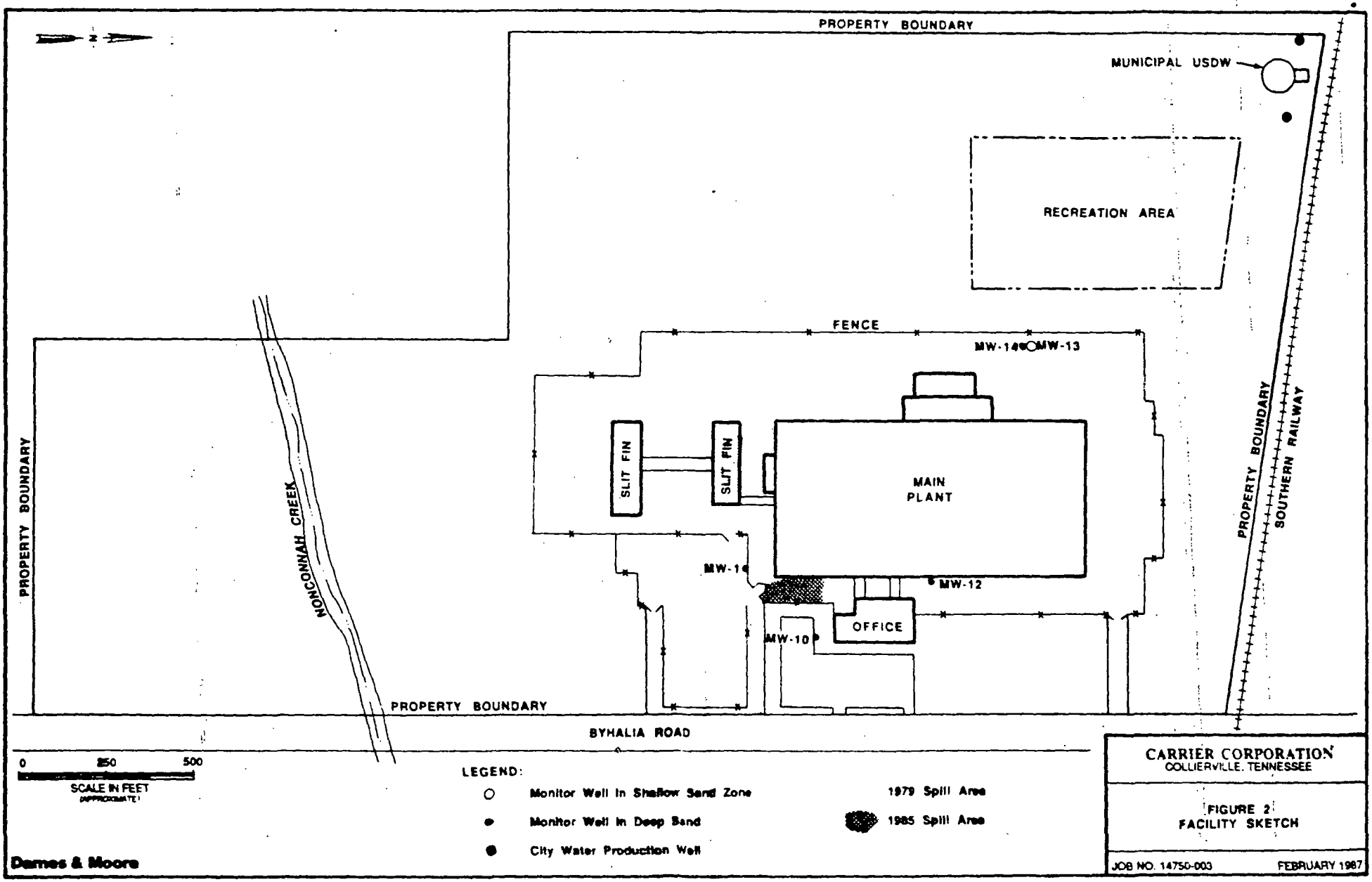
CARRIER SITE

VICINITY MAP

Source Base Map By USGS: Collierville, Tennessee Quadrangle

Date 1973

1 0 1 KILOMETER


PROPERTY BOUNDARY
MUNICIPAL USDW
RECREATION AREA
FENCE
MW-14
MW-13
SLIT FIN
SLIT FIN
MAIN PLANT
MW-11
MW-12
OFFICE
MW-10
PROPERTY BOUNDARY
SOUTHERN RAILWAY
PROPERTY BOUNDARY
NONCONNAH CREEK
PROPERTY BOUNDARY
BYHALIA ROAD
0
250
500
SCALE IN FEET
(APPROXIMATE)
LEGEND:
Monitor Well in Shallow Sand Zone
Monitor Well in Deep Sand
City Water Production Well
1979 Spill Area
1985 Spill Area
Dames & Moore
CARRIER CORPORATION
COLLIERVILLE, TENNESSEE
FIGURE 2
FACILITY SKETCH
JOB NO. 14750-003
FEBRUARY 1987

there are three potential sources of trichloroethylene (TCE) on the property and that the site may be the source of trace concentrations of trichloroethylene found in City of Collierville Wellfield #2 wells which are located within 2000 feet of the plant building. The three potential sources identified as: a 1979 trichloroethylene leak, a closed unlined lagoon, and a 1985 trichloroethylene leak.

1979 Trichloroethylene Spill

In 1979, the Carrier plant experienced a spill of trichloroethylene from a heated degreasing unit located on the south side of the plant. The spill occurred as a result of the failure of a filter cover on the unit. At the time of the spill it was estimated that several thousand gallons of tricholorethylene were lost. The solvent collected on the plant's south parking lot. Residual material was washed off the parking lot by the municipal Fire Department in a generally eastern and southern direction. The asphalt parking lot was reportedly softened by the absorption of solvent; and was therefore removed for off-site disposal. (1)

A subsequent 1981 investigation of the spill involving test borings and soil analyses was negative for tricholoroethylene. The investigation involved borings to 30 feet. (2)

Clarifier Sludge Lagoon

In or about 1972, Carrier installed a wastewater lagoon on the northwest corner of the property. Data from the state's Site Investigation Report indicates that the lagoon was approximately 50' by 48' and contained approximately one foot of sludge at the time it was removed in 1980. The lagoon was used for the storage of clarifier pit sludge which was essentially an alkaline zinc phosphate washer sludge according to plant personnel. (3)

The exact location and construction details of the lagoon have not been determined. An undated topographic map and an aerial photograph of the area appear to show an outfall ditch in the southwest corner of the lagoon. The ditch appears to terminate in a topographic depression near the lagoon. The topography of the lagoon area was changed when the lagoon and a layer of subsoil beneath it were removed in 1980.

1985 Trichloroethylene Spill

On January 23, 1985 Carrier experienced a second spill of trichloroethylene as a result of a leaking underground pipe from a tank holding trichloroethylene. It was estimated at the time of the spill that approximately 500 gallons of trichloroethylene was spilled; and approximately the same amount was recovered. In addition substantial amounts of soil contaminated by trichloroethylene were removed from the area of the leak and disposed off-site in a plan approved by the Tennessee Department of Health and Environment. (4)

A groundwater investigation was conducted following soil removal to assess the impact of the leak on groundwater resources. As part of this investigation, five monitoring wells were installed on the property. They are shown on Figure 2. Two of these wells, one screened in the upper sand and one screened in the lower sand, have shown measurable concentrations of trichloroethylene. (5)

Other Potential Sources

Carrier Air Conditioning personnel indicate that they are aware of no other potential sources of trichloroethylene contamination on the property.

1.3 Objectives of the Plan

The Site Investigation Plan has been prepared to meet the following objectives:

I. Characterize the "Sources" of Contamination - Identification of the dimensions and variables associated with each potential source of contamination is vital to an understanding of whether these sources continue to pose a threat to human health and the environment on or off site. The primary focus of this objective will be to characterize the dimensions of the 1979 and 1985 spill events and the former wastewater storage lagoon on the property. The remaining impact of these sources is predominately soil, subsoil, and groundwater contamination; however, the proximity of 1979 and 1985 spill events are such that it may be impossible to differentiate between them with respect to subsequent soil and/or groundwater contamination.

II. Define the extent of contamination into applicable media - It is anticipated that surface and subsurface soils, and groundwater are the media most likely to be affected.

III. Characterize the geohydrology of the site - This characterization will serve as a basis for descriptions of the potential for groundwater contamination and provide the data needed to plan remedial actions if necessary. The geohydrological investigation will be conducted at the Carrier Air Conditioning Company plant in Collierville. In particular, it is the objective of the Plan to establish the relationship between the shallow sand aquifer on the site and the deeper sand aquifer on site, if possible.

IV. Recommend feasible approaches, if required, to eliminate or reduce the environmental impact of the contamination.

1.4 Summary of Technical Approach

Prior site studies have established the basic context of the potential environmental problem associated with this site;

namely, trichloroethylene contamination in the unsaturated zone and underlying groundwater formations, for which the potential receptors are public and private groundwater resource users. There is no apparent evidence of atmospheric or biological pathways, and surface water pathways appear to be associated with soil contamination only.

Therefore the technical approach for this investigation will focus on soil, subsoils, and groundwater contamination by trichloroethylene. In those portions of the investigation associated with the old lagoon, the parameter list will be expanded beyond trichloroethylene to include those constituents believed potentially present in the plant's clarifier sludge in 1980.

2.0 TECHNICAL INVESTIGATION PLAN

The following is a description of the technical investigation planned for the Carrier site and a rationale for each work task.

2.1 Site Background Data Collection

A search for available background data on the site was initiated by the state Division of Superfund in 1986 and has been continued by EnSafe and Carrier. Background data collected to date has been limited to Carrier sources relating directly to the property, and the three potential releases. Additional data and sources to be searched are described below.

A search for background data, including hydrogeologic and site historical information, has been initiated for the Carrier site and vicinity. Sources being surveyed for relevant information include the State of Tennessee Geological Survey and other state agencies; the United States Geological Survey; Army Corps of Engineers; USDA - Soil Conservation Service; local water and sewer utilities; and other sources which may produce hydrologic data.

Geologic profiles and boring logs are being compiled from publications and previous site investigations. Well logs for local municipal and domestic wells will be collected from state and local agencies. The Collierville Water Department will be contacted to supply existing pump test data for the two nearby municipal water wells, if this information exists.

Aerial photographs of the Carrier plant site and surrounding area have been ordered. These photographs will be used to identify local land use activities and potential contaminant source areas. Geologic maps obtained from state and federal geologic surveys will be used to assess the regional geologic setting.

Laboratory analytical data is being compiled from previous investigations of soil and groundwater at the site, and from the Collierville Water Department. This information will be used in assessing the historical events and groundwater quality at the site. In addition to the data gathering described above, a search of publications documented by the National Water Well Association will be conducted. The search will be performed to identify published reports containing hydrogeologic data pertinent to the Collierville area and material dealing with trichloroethylene characteristics, mobility, and spill remediation.

Soil samples from some of the previous exploratory borings made at the site have been maintained in storage. These samples will be geologically logged by a trained geologist from Dames & Moore for comparison with the original logs. They will be used to become visually familiar with the lithologic units present in the area prior to initiating the field activities.

Also to be developed is contaminant specific data on trichloroethylene. Literature data related to the physical/chemical characteristics, mobility, degradation, and environmental behavior of the chemical will be obtained.

2.2 Surface Water Investigations

The nature of the potential releases at the site are such that surface water impacts are expected to be limited to the possibility of contaminated run off, probably resulting from the erosion of contaminated soils. To provide quantitative data on surface water impacts, samples will be collected once during the project in storm water run off channels on the property. A preliminary site evaluation indicates two probable storm water sampling points: the ditch parallel to Byhalia Rd. in front of the plant, and a ditch which traverses the property on a north-south axis. Both ditches flow into Nonconnah Creek. Grab samples of stream water and sediment will be collected once at these two locations

and in Nonconnah Creek upstream of the ditches and downstream of the ditches; resulting in four water and four sediment samples. These samples will be analyzed for trichloroethylene.

2.3 Geologic Investigations

Geophysical Surveying

Each of the four existing and six proposed deep well borings (greater than 80 feet) on the Carrier site will be surveyed, using a natural gamma ray logging instrument. This will be performed using a Mount Sopris Instrument Company, Model 1000-C portable borehole logger (or similar instrument) with a gamma detection probe. The Mount Sopris unit has a continuous chart-type recorder. Gamma logging of the proposed deep borings will be performed at the time of boring completion.

The gamma logging of the deep borings should aid the geologic correlation and thickness determinations of the sandy aquifer and clay aquitard units present at the site. It will also be used to verify the geologic descriptions on file for the existing wells.

Because this investigation deals with an organic chemical contaminant in an area of unconsolidated sediments, only gamma ray logging will be performed since it can be conducted through cased wells. No surface geophysical surveys are anticipated as part of this investigation.

Monitoring Wells

A total of 17 borings will be completed as groundwater monitoring wells; these will be used to obtain groundwater samples for laboratory analysis and to measure groundwater elevations. Three shallow wells will be constructed next to existing deep wells MW-1, MW-10, and MW-12. Fourteen wells will be constructed in nests of two (one deep and one shallow) at six locations between the Carrier plant and the municipal well field. These wells will

UNITED TECHNOLOGIES CARRIER

Carrier Corporation

97 South Byhalia Road
Collierville, Tennessee 38017
(901) 853-9761

November 10, 1987

Mr. Paul Patterson
Tennessee Department of Health and Environment
Division of Solid Waste Management
Room 1101, State Office Building
170 N. Mid-America Mall
Memphis, Tennessee 38013

Dear Mr. Patterson:

Because of data developed to date in the Site Investigation of the Carrier Corporation, Collierville, Tennessee plant, we have found it necessary to slightly revise our Site Investigation Plan.

Enclosed is a copy of the revision for your information. If you have any questions, do not hesitate to call me at (901) 853-9761.

Very truly yours,

Carl Krull
Environmental Engineer

CWK:fg
Enclosure

ADDENDUM TO THE SITE INVESTIGATION PLAN FOR CARRIER CORPORTATION Collierville, TN

Prepared by
Environmental and Safety Designs, Inc.

November 9, 1987

1.0 INTRODUCTION

The following is an addendum to the Site Investigation Plan for the Carrier Corporation Plant in Collierville, Tennessee. The addendum has been prepared in accordance with the Site Sampling Plan approved by the Tennessee Department of Health and Environment in July, 1987.

2.0 SOIL-GAS SURVEY

A soil-gas survey will be conducted based upon the laboratory results (Appendix A) for trichloroethylene in soil samples obtained in the area of the old lagoon. The purpose of this survey is to define the areal extent of potential contamination in the former lagoon area, and to aid in determining the placement of the Phase 2 monitoring wells.

A sample grid will be developed in the area suspected of high contamination based on previous findings. The grid will be set to optimize identification of the area impacted by the old lagoon. At each point a 15 foot deep, 4-inch boring will be augered. The annulus of the borehole will be covered with plastic and allowed to sit for up to 24 hours. Each borehole will then be monitored for any vapors that may have accumulated in the elapsed time using an organic vapor detector. Each borehole will be backfilled with existing soils upon completion of monitoring.

Laboratory results indicate that sample B-17 contained the highest quantity of trichloroethylene in the area of the old lagoon. This location will be used as the center point of the grid. A north - south line (x-axis) and an east - west line (y-axis) will run through this location. Each of these lines will contain boring locations to determine the length and width of the lagoon. Additional augering will continue at systematic intervals perpendicular to the x and y axes to complete the areal dimensions of the impacted area.

3.0 REVISED BORING LOCATIONS

The sampling plan for the Carrier site investigation allowed for up to 30 boring locations. During phase 1 of the investigation 20 borings were completed. An additional 8 borings will be conducted in Phase 2.

Laboratory results indicate an area of high trichloroethylene contamination immediately south of the main Carrier plant. Therefore, the 8 boring locations will be moved to supplement phase 1 sampling data. Two to three borings will be placed in the vicinity of samples B-4 and B-9. These borings will further show the distribution of soil contamination. Split-spoon sampling will continue to a depth of 35 to 50 feet for laboratory analyses to insure the bottom of the contaminant layer has been defined.

Two to three borings will be placed in the area southeast of monitoring well 1 (MW-1). These borings will be used as data points, and split-spoon samples will be collected to a depth of 35 to 50 feet for laboratory analyses.

One boring will be placed between the slit fin buildings on the northwest side. A final boring will be placed slightly downgradient from the southeastern most well pair, now designated as monitoring wells 3 and 4 (MW-3, MW-4).

4.0 MONITORING WELLS

The levels of TCE identified in the old lagoon area during phase 1 are high enough to suggest that the old lagoon may be a potential source of the observed groundwater contamination. To further investigate this potential source we will relocate the well pair planned for the natural depression. This change in the work plan is supported by phase 1 data which was negative for TCE at the natural depression.

Five shallow monitoring wells will be installed in the next phase of field work. They will be placed as follows: three (3) surrounding the old lagoon; one (1) southwest of the plant; and one (1) reserved for an upgradient well as described below. Locations of deep wells planned for the site are being will be selected based on monitoring data obtained from the shallow well installations.

In the absence of an uncontaminated upgradient well, further investigation will be conducted east of the plant to determine the feasibility of installing an upgradient well between existing MW #4 and Nonconnah Creek. Since this investigation must be conducted off Carrier owned property, it is contingent upon receipt of approval from affected landowner(s).

5.0 SAFETY MONITORING

During phase 1 of the Carrier site investigation both an organic vapor detector and a scanning infrared spectrophotometer were used for TCE vapor monitoring. Results from both instruments were found to be similar. Therefore, for cost effectiveness and the elimination of redundancy in monitoring, use of the infrared spectrophotometer will be omitted in subsequent field activities.

6.0 MONITOR WELL SAMPLING

The levels of TCE contamination in monitoring wells MW-10, MW-12, and MW-14 have continuously been below detectable limits since sampling was initiated in September of 1986 (Appendix B). The consistency of this data suggests that these wells are not within the contaminant plume. To reduce unnecessary expenditures sampling of these wells will be reduced from monthly to annually. Furthermore, if any new monitoring well shows non-detectable values for TCE contamination upon initial sampling and for a period of 2 consecutive months then any additional samples will be collected annually. All existing wells and all new wells

showing contamination will continue to be monitored on a monthly basis.

7.0 REMOVAL OF MONITORING WELL 1

The Carrier Site Investigation Plan stated that MW-1 would be removed after the installation of a deep replacement well, MW-1B. This Plan was based upon the hypothesis that monitoring well 1 was allowing the passage of contaminants between aquifers. However, the new deep monitoring well (MW1-B) shows contaminant levels greater than those of MW-1. Consequently, MW-1 will remain for additional data support and may be removed at a later time.

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APPENDIX A
Trichloroethylene Test Results
Phase 1 Borings

SAMPLE	DEPTH	LAB RESULTS
B_1	.5-2.0	<.5 ppb
	3.5-5.0	6 ppb
	8.5-10.0	12 ppb
	13.5-15.0	5 ppb
	18.5-20.0	25 ppb
B_2	.5-2.0	14 ppb
	3.5-5.0	127 ppb
	8.5-10.0	230 ppb
	13.5-15.0	1270 ppb
	18.5-20.0	2600 ppb
B_3	.5-2.0	17 ppb
	3.5-5.0	N/A
	8.5-10.0	43 ppb
	13.5-15.0	44 ppb
	18.5-20.0	21 ppb
B_4	.5-2.0	250000 ppb
	3.5-5.0	750 ppb
	8.5-10.0	540 ppb
	13.5-15.0	240 ppb
	18.5-20.0	40 ppb
B_5	.5-2.0	87 ppb
	8.5-10.0	840 ppb
	13.5-15.0	770 ppb
	18.5-20.0	1850 ppb
B_6	.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	24 ppb
	18.5-20.0	26 ppb
B_7	.5-2.0	3 ppb
	3.5-5.0	20 ppb
	8.5-10.0	16 ppb
	18.5-20.0	<.5 ppb
B_8	.5-2.0	10 ppb
	3.5-5.0	14 ppb
	8.5-10.0	52 ppb
	13.5-15.0	19 ppb
	18.5-20.0	20 ppb
B_9	.5-2.0	48000 ppb
	3.5-5.0	22000 ppb
	8.5-10.0	1550000 ppb
	13.5-15.0	3100 ppb
	18.5-20.0	6300 ppb
B_{10}	.5-2.0	3 ppb
	3.5-5.0	4 ppb
	8.5-10.0	3 ppb
	18.5-20.0	12 ppb

SAMPLE	DEPTH	LAB RESULTS
B_{11}	.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	<.5 ppb
	18.5-20.0	<.5 ppb
B_{12}	.5-2.0	<.5 ppb
	3.5-5.0	2 ppb
	8.5-10.0	21 ppb
	18.5-20.0	42 ppb
B_{13}	.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	<.5 ppb
	18.5-20.0	<.5 ppb
B_{14}	.5-2.0	<.5 ppb
	3.5-5.0	0.9 ppb
	8.5-10.0	9 ppb
	18.5-20.0	11 ppb
B_{15}	COMPUCHEM FOR PRIORITY POLLUTANTS	
B_{16}	.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	33 ppb
	18.5-20.0	19 ppb
OLD UNLINED LAGOON		
B_{17}	3.5-5.0	15000 ppb
	13.5-15.0	168000 ppb
	18.5-20.0	960 ppb
B_{18}	3.5-5.0	16000 ppb
	13.5-15.0	2100 ppb
	18.5-20.0	130 ppb
B_{19}	3.5-5.0	840 ppb
	13.5-15.0	920 ppb
	18.5-20.0	10 ppb
B_{20}	(ADJACENT TO GRAVEL ROAD)	
	.5-5.0	3 ppb
	8.5-10.0	<.5 ppb
B_{21}	0.5-2.0	6900 ppb
	3.5-5.0	20000 ppb
	8.5-10.0	800 ppb
	13.5-15.0	8000 ppb
	18.5-20.0	11000 ppb
	23.5-25.0	2300 ppb
	28.5-30.0	230 ppb
	33.5-35.0	3 ppb
	38.5-40.0	1900 ppb
	43.5-45.0	16 ppb

SAMPLE	DEPTH	LAB RESULTS
B_{22}	0.5-2.0	113 ppb
	3.5-5.0	7 ppb
	8.5-10.0	19 ppb
	18.5-20.0	11 ppb
B_{23}	0.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	<.5 ppb
	18.5-20.0	5 ppb
B_{24}	0.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	<.5 ppb
	18.5-20.0	<.5 ppb
	28.5-30.0	<.5 ppb
	38.5-40.0	.5 ppb
	48.5-50.0	2 ppb
B_{25}	0.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	<.5 ppb
	18.5-20.0	<.5 ppb
B_{26}	0.5-2.0	260 ppb
	3.5-5.0	300 ppb
	8.5-10.0	220 ppb
	18.5-20.0	440 ppb
	28.5-30.0	3 ppb
	33.5-35.0	80 ppb
	38.5-40.0	230 ppb
B_{27}	0.5-2.0	7 ppb
	3.5-5.0	2 ppb
	8.5-10.0	110 ppb
	18.5-20.0	600 ppb
	28.5-30.0	15 ppb
	38.5-40.0	220 ppb
	48.5-50.0	27 ppb
	53.5-55.0	3000 ppb
B_{28}	0.5-2.0	<.5 ppb
	3.5-5.0	<.5 ppb
	8.5-10.0	6 ppb
	13.5-15.0	10 ppb
	18.5-20.0	220 ppb

APPENDIX B

Trichloroethylene Test Results
On Site Monitoring Wells

TRICHLOROETHYLENE ANALYTICAL RESULTS
TCE & DCE CONCENTRATION (ug/l)

DATE	WELL #1	WELL #10	WELL #12	WELL #13	WELL #14	WELL #1B	WELL #3	WELL #4	WELL #5	WELL #6
09/15/86	260	2.4	<1.0	105*	<1.0	-----	-----	-----	-----	-----
10/20/86	53	1.0	<1.0	120*	<1.0	-----	-----	-----	-----	-----
10/28/86	64	2.8	<1.0	100*	<1.0	-----	-----	-----	-----	-----
11/03/86	210	<1.0	<1.0	110*	<1.0	-----	-----	-----	-----	-----
11/12/86	65	<1.0	<1.0	100*	<1.0	-----	-----	-----	-----	-----
11/20/86	38	<1.0	<1.0	110*	<1.0	-----	-----	-----	-----	-----
12/04/86	46*	<1.0	<1.0	97	<1.0	-----	-----	-----	-----	-----
12/11/86[1]	110*	-----	-----	92	-----	-----	-----	-----	-----	-----
12/17/86	115*	-----	-----	110	-----	-----	-----	-----	-----	-----
12/23/86[2]	73/140*	-----	-----	120	-----	-----	-----	-----	-----	-----
12/30/86	82*	-----	-----	77	-----	-----	-----	-----	-----	-----
01/07/87	105*	-----	-----	98	-----	-----	-----	-----	-----	-----
01/22/87	81/130*	-----	-----	110	-----	-----	-----	-----	-----	-----
01/29/87	120*	-----	-----	120	-----	-----	-----	-----	-----	-----
02/12/87	110*	-----	-----	120	-----	-----	-----	-----	-----	-----
02/18/87	125*	-----	-----	130	-----	-----	-----	-----	-----	-----
02/26/87	110/130*	-----	-----	130	-----	-----	-----	-----	-----	-----
03/05/87	110/130*	-----	-----	140	-----	-----	-----	-----	-----	-----
03/12/87	155*	-----	-----	160	-----	-----	-----	-----	-----	-----
03/20/87	125*	-----	-----	140	-----	-----	-----	-----	-----	-----
03/25/87	190*	<1.0	<1.0	230	<1.0	-----	-----	-----	-----	-----
04/03/87	170/140	-----	-----	160*	-----	-----	-----	-----	-----	-----
04/09/87	130	-----	-----	160*	-----	-----	-----	-----	-----	-----
04/16/87	140	-----	-----	160*	-----	-----	-----	-----	-----	-----
04/23/87	180	-----	-----	190*	-----	-----	-----	-----	-----	-----
04/30/87	180	-----	-----	195*	-----	-----	-----	-----	-----	-----
05/06/87	150	-----	-----	145*	-----	-----	-----	-----	-----	-----
05/14/87	130*	-----	-----	140	-----	-----	-----	-----	-----	-----
05/21/87	220/190*	-----	-----	210	-----	-----	-----	-----	-----	-----
05/28/87	260/200*	-----	-----	190	-----	-----	-----	-----	-----	-----
06/04/87	130	-----	-----	140	-----	-----	-----	-----	-----	-----
06/11/87	-----*	-----	-----	150	-----	-----	-----	-----	-----	-----
06/18/87	220*	-----	-----	210	-----	-----	-----	-----	-----	-----
06/25/87	140/160*	-----	-----	140	-----	-----	-----	-----	-----	-----
07/02/87	200*	-----	-----	180	-----	-----	-----	-----	-----	-----
07/09/87	191*	-----	-----	160	-----	-----	-----	-----	-----	-----
07/16/87	222/273*	-----	-----	59	-----	-----	-----	-----	-----	-----
07/23/87	235*	<1.0	<1.0	180	<1.0	-----	-----	-----	-----	-----
08/20/87	195*	<1.0	<1.0	160	<1.0	235	-----	-----	-----	-----
08/27/87	241*	-----	-----	-----	-----	413	-----	-----	-----	-----
09/03/87	212	-----	-----	-----	-----	404*	-----	-----	-----	-----
09/17/87	203*	-----	-----	-----	-----	304/341	-----	-----	-----	-----
09/28/87	165*	-----	-----	-----	-----	300	-----	-----	-----	-----
10/15/87	223	<1.0	<1.0	100	<1.0	357	5200	48	6960	<1.0

* Indicates that the sample was collected in duplicate. If the results of duplicate samples are within 10% of each other, the average of the two results is reported, but if the results are not within 10% of each other both results are reported.

1 Dedicated well pump installed on Monitoring Well #1

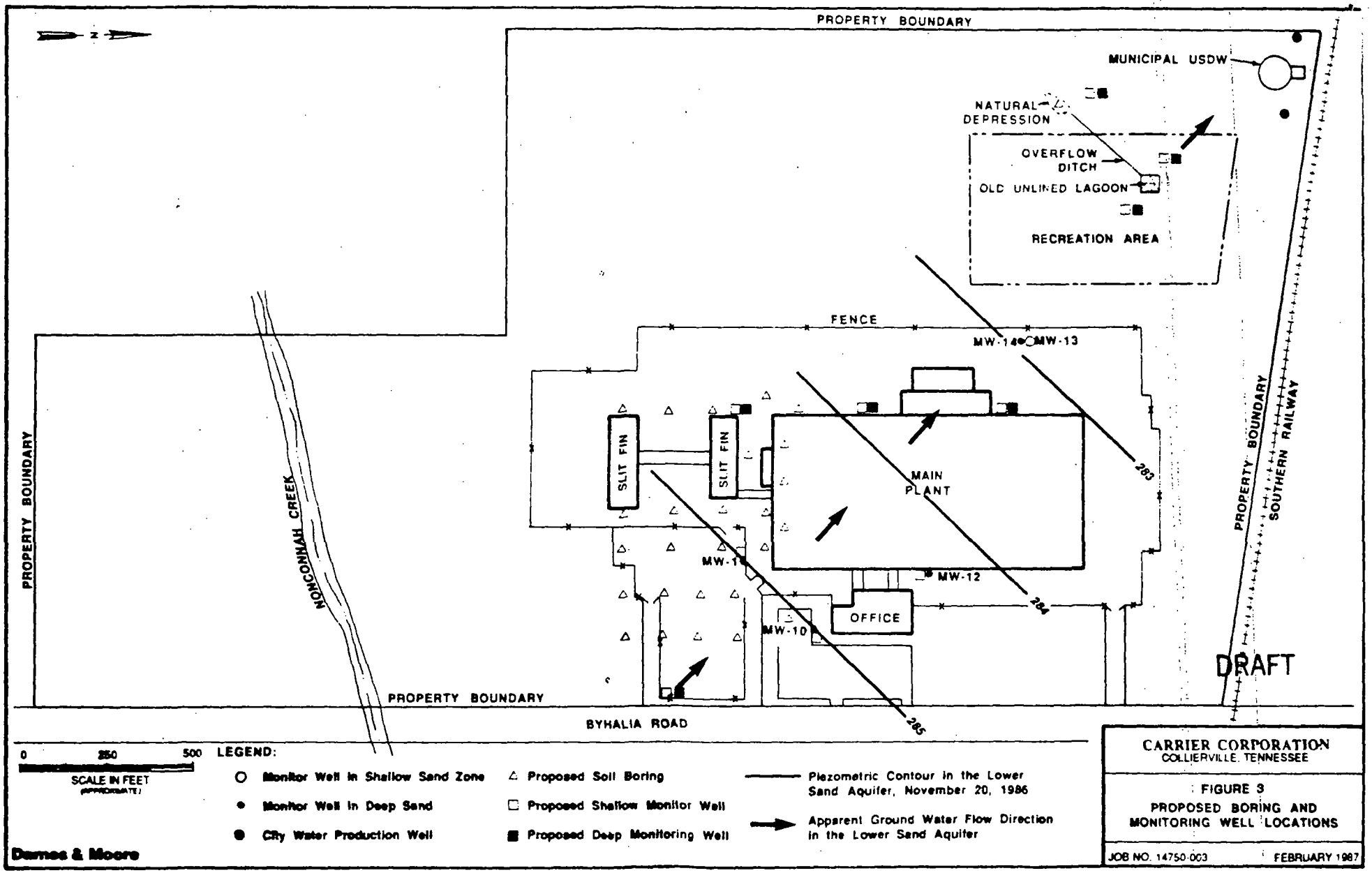
2 Dedicated well pump installed on Monitoring Wells #13, #10, and #14. Pumps were installed in other wells after development.

be installed in order to delineate contaminant plumes within both the upper and lower aquifer units, and to track the migration of the contaminants from the potential source areas to the municipal wells. The probable location of all the wells is shown on the proposed well location plan (Figure 3). However, the locations of the nested wells may be changed following evaluation of the preliminary data search, and experience gained in installing the 3 shallow wells and shallow soil borings.

If the data search conducted for this investigations does not produce sufficient data on the aquifer characteristics at the site, specifically pump test results on the nearby municipal wells, an additional well may be installed near existing well MW-10 for use as an observation well in the performance of an aquifer pumping test.

All of the borings for the shallow monitoring wells will be drilled using hollow-stem auger techniques. Depths of the shallow wells will range between 30 and 55 feet. Borings for the deeper monitoring wells will range in depth from 80 to 120 feet. Hollow-stem auger techniques will also be used for these borings; however, drilling conditions encountered may necessitate switching to the use of mud rotary techniques in the deeper borings.

Soil samples will be collected at 2.5 foot intervals using a standard 2-inch O.D. split-spoon sampling tool. Each sample will be classified in the field by an experienced geologist and the samples will then be placed in labeled glass jars. For each sample, the field geologist will also record indications of odor or visual contamination that may aid in future evaluation of data. Each well will be installed with a column of 2-inch diameter PVC riser attached to a 10-foot length of stainless screen placed in the lower section of the drilled hole. Shallow wells will be screened from the interface of the clay aquitard through the bottom 10 feet of the shallow aquifer unit.


N
PROPERTY BOUNDARY
MUNICIPAL USDW
NATURAL DEPRESSION
OVERFLOW DITCH
OLD UNLINED LAGOON
RECREATION AREA
FENCE
MW-14
MW-13
SLIT FIN
SLIT FIN
MAIN PLANT
MW-11
MW-12
OFFICE
MW-10
283
284
285
PROPERTY BOUNDARY
NOMCONNAH CREEK
PROPERTY BOUNDARY
SOUTHERN RAILWAY
PROPERTY BOUNDARY
BYHALIA ROAD
DRAFT
0
250
500
SCALE IN FEET
(APPROXIMATE)
LEGEND:
Monitor Well in Shallow Sand Zone
Monitor Well in Deep Sand
City Water Production Well
Proposed Soil Boring
Proposed Shallow Monitor Well
Proposed Deep Monitoring Well
Piezometric Contour in the Lower Sand Aquifer, November 20, 1986
Apparent Ground Water Flow Direction in the Lower Sand Aquifer
Dames & Moore
CARRIER CORPORATION
COLLIERVILLE, TENNESSEE
FIGURE 3
PROPOSED BORING AND MONITORING WELL LOCATIONS
JOB NO. 14750-003
FEBRUARY 1987

Deeper wells will be screened so that the groundwater surface in the lower aquifer unit lies within the upper 2 feet of the screened section of the well. The screened section of each well will be backfilled with clean silica sand to approximately 3 feet above the top of the screen, sealed with at least 2 feet of granular bentonite, followed by 2 feet of sand, and backfilled to the surface with a cement/bentonite grout. A protective steel casing will be installed at the surface with a locking cap for security. The top of each well casing will be surveyed to establish the elevation relative to datum used for the existing monitor wells.

Deep monitoring wells will be constructed by augering to the clay aquitard unit to create a large diameter (6-inch minimum diameter) borehole. This boring will then be cased with 4-inch minimum ID PVC casing and grout sealed in place. The boring will then be advanced through the clay aquitard and into the lower aquifer unit using mud rotary techniques. Soil samples will be collected on 5-foot intervals below the outer casing. Gamma logs will then be used to interpolate the geology between samples. This method will effectively prevent the possibility of cross-contamination between aquifers. The 2-inch diameter well casing and stainless screen will then be installed. A larger diameter outer casing may be required to adequately install the deep wells. The secondary method of well construction would then involve drilling a larger diameter borehole and installing an 8 inch to 10 inch I.D. PVC outer casing.

If conditions encountered during drilling prevent the use of either of the methods described above, the deep wells will be installed by driving the casing to the clay aquitard. A 10-inch diameter steel casing will be installed by cable tool so as to penetrate at least the upper 2 feet of clay. The boring may also need to be continued using mud rotary techniques if conditions prevent the use of hollow-stem augers to the target depths. It

is doubtful that hollow stem augers can be used below the upper sand unit.

None of the well installations will be placed in areas found to have highly contaminated soils during the drilling. If significantly high concentrations of TCE are detected, the borehole will be abandoned and the drilling moved to a different location. This procedure will be followed to protect the integrity of the wells and to avoid potential cross contamination between the aquifer units.

Shallow Soil Borings

Eighteen initial shallow soil borings will be made specifically to investigate the nature and distribution of soil contamination. A total of 25 shallow borings is anticipated to adequately delineate the extent of the source areas. Three potential sources of TCE contamination have been identified at the Carrier plant. The 1985 spill area south of the office building has been investigated previously and the data generated will be utilized in the site assessment. Another spill of TCE occurred near the southwest corner of the main plant and the closest "slit fin" building. The initial soil borings approximately 20 feet in depth will be made to investigate this spill site. This is a rather large area since the spill reportedly covered much of the former parking lot area. Monitoring well MW-1 has shown significant levels of TCE and the proposed shallow borings will be used to locate and assess the source of contamination.

The third potential source area is a closed unlined lagoon which was used to handle clarifier sludges. The exact location of this lagoon is being researched. Four soil borings are being reserved for investigation of this area. Proposed locations of shallow soil borings are shown on Figure 3.

Soil samples will be split vertically after being logged by the site geologist. One sample will be preserved for laboratory

analysis. The other sample will be kept on site at room temperature for a period of at least 24 hours. At that time, a portable field instrumentation will be used to measure the head-space concentrations of TCE in each sample jar. Various field technologies will be evaluated for use on the site. At present a Photovac gas chromatograph, a direct reading infra-red analyzer, and organic vapor monitors are being considered. The instrumentation will also be used to measure accumulated TCE vapors in each boring approximately 1 hour and 24 hours after completion of the borings. Open bore holes will be kept covered during this period. After the vapor concentrations have been measured in each soil boring, it will be backfilled with a bentonite and sand mixture with a 2-foot cement cap at the surface.

Sequence of Drilling

The drilling operations proposed for this investigation will be conducted in an orderly and systematic manner in order to optimize the value of each boring. Preliminary data collection will preceed the field work in order to verify or relocate the proposed boring and well locations. Shallow wells will be installed adjacent to the three existing deep monitoring wells (MW-1, MW-10, and MW-12) as the first task when field operations begin. This will enable the collection of groundwater level data and gradient calculations for both aquifer systems while other field operations proceed. Up to eighteen initial shallow soil borings will be made to investigate potential source areas contributing to the contamination at the site. These results may have an impact on the locations of several of the proposed nested well installations.

Based on the results of the shallow soil borings and groundwater surface measurements, the locations of the proposed nested wells will be re-evaluated. The wells will then be installed. Shallow monitoring wells at each well pair location will be installed first. This will be done so that the actual length of outside casing can be determined before it is needed. The outer casing

for the deep well will then be installed and grouted. After the casing has been securely grouted, the deep boring will be continued and the 2-inch PVC well casing and stainless screen installed.

Decontamination

In order to prevent cross-contamination between boreholes, the augers and all down-hole tools will be steam cleaned before and after each boring. All casing and screen will be washed and swabbed with a tri-sodium phosphate (TSP) solution and steam cleaned prior to installation. Sampling tools will be decontaminated using a preliminary rinse and a TSP solution wash followed by a potable water rinse between each sample.

Well Development

Upon completion of each monitoring well the drill crew will develop the well to insure proper communication between the aquifer and the well. This will be accomplished by using either a pumping, backwash, or surging method, or some combination of the three. Compressed air will not be used to develop the wells. Development will continue until a sample of the groundwater is free of sand and turbidity is at a minimum.

Aquifer Testing

No aquifer tests are anticipated during this investigation. since there are two high capacity municipal wells near the site, a background data search will include looking for pumping test data on these wells. If this information is not available, the hydraulic conductivity of the two aquifer units will be estimated using grain size distribution curves derived from soil sample analyses.

If an aquifer test is necessary to characterize the lower aquifer, an aquifer pumping test can be performed using well MW-10 (4-inch diameter). An observation well would have to be installed near MW-10. The test could be conducted using a sub-

mersible pump operated on a generator. A transmissivity and storage coefficient value could be calculated from this test. Specific capacity could also be calculated for the pumping well.

2.4 Unsaturated Zone Investigation

Grain size distribution analyses will be performed on representative soil samples collected during the site investigation. The gradation curves constructed from the results will be used to estimate the hydraulic conductivity for each stratigraphic unit using the Hazen formula.

Soil samples will be tested for volatile organic vapor (TCE) content on-site using a head-space analysis field technique. Samples will be stored in moisture proof glass jars and kept at room temperature for 24 hours. The detection probe will then be inserted into the top of the sample jars to measure the accumulated organic vapors. The maximum concentration measured will be recorded for that sample. This preliminary testing will be used to screen samples sent to the laboratory for analysis.

It appears that extensive data on the upper soils is available from previous geotechnical evaluations of the site as well.

2.5 Receptors Investigation

No "off site" field sampling is planned for the Carrier Site Investigation; however data relative to the use of shallow and deep groundwater resources within a three mile radius will be collected. (Note. Acquisition of this information has been originated by TDHE and the Memphis Shelby County Health Department.) Descriptions of the Collierville City Water Supply System will also be obtained.

2.6 Atmospheric Investigations

No atmospheric investigatory tasks are planned for the Carrier Site Investigation. Although the contaminant of concern, trichloroethylene is very volatile, its presence in only trace concentrations in groundwater and subsoils does not pose a significant atmospheric pathway.

Localized air quality monitoring for organic vapors and trichloroethylene is planned as a component of the Health & Safety Plan for the investigation however.

2.7 Biological/ecological Investigations

Biological sampling is not planned for the Carrier Site Investigation. There are no probable biological pathways, other than groundwater, nor is the site ecologically significant.

3.0 SAMPLING PLAN

Prior to the initiation of field sampling activities, a Site Sampling Plan will be developed. The Sampling Plan is being specified as a deliverable; however the basic outline and content of the Sampling Plan are specified below.

3.1 Objectives

The occurrence of at least two spills of TCE and a closed unlined sludge lagoon which at one time held sludges which may have contained TCE have been documented at the Carrier site. As a result of one or more of these potential sources, elevated concentrations of TCE have been detected in the soils and groundwater at the site. Low concentrations of TCE have since been detected in the groundwater from the nearby municipal wells.

The objectives of this sampling plan are to locate the sources of TCE migrating from the site, assess the route(s) of migration, and delineate the areas of soil and groundwater contamination. A series of shallow exploratory soil borings will be used to locate TCE contaminated soil areas which are source areas for TCE entering the groundwater regime. Groundwater monitoring wells will then be installed to assess both the local geology and potential contaminant plume migration routes and to delineate the extent of groundwater contamination.

3.2 Evaluation of Existing Data

The sampling plan will contain a discussion of existing data sources and the quality of that data. A wide range in data acceptability is anticipated.

3.3 Determination of Chemical Contaminants of Interest

The principal contaminant of interest is trichloroethylene. It is anticipated that all water and selected soil samples will be

subjected to analysis for trichloroethylene. Analytical parameters of interest in the area of the old lagoon will include the priority pollutant list.

3.4 Determination of Sample Types

Samples of surface soils, subsurface soils, groundwater, surface run off water, and drinking water will be analyzed.

3.5 Sampling Locations and Frequencies

Soil Samples

Soil samples will be collected from each of the proposed boring and well locations. Shallow soil borings will be used to identify the source area(s) of groundwater contamination. The borings will be drilled in the approximate locations shown on Figure 3. Soil samples from each boring will be collected at 5-foot intervals using a split-spoon sampling device. These samples will be visually classified by an experienced geologist. The samples will then be split into representative samples. Each sample will be placed in a separate moisture-proof glass jar and labeled for identification. One sample jar will be preserved in a cool ice chest to be transported to the analytical laboratory. Sample containers for analytical samples will be either 40 ml vials or 4 ounce wide mouth jars which will be packed with soil sample to minimize head-space in the jar. The other sample will be kept in a standard sample jar at room temperature for at least 24 hours. A qualitative head-space analysis will then be performed using a Photovac gas chromatograph or OVA to measure TCE vapor concentrations accumulated in the sample jar. Soil samples will be chosen for laboratory analysis based on the results of the head-space analysis. This method will enable the source area(s) to be identified based on relative TCE concentrations measured at various locations and depths.

It is estimated that 18 to 25 soil borings will be made at the site to characterize the potential source areas. Each boring will be drilled to a depth of 20 feet. Soil samples will be collected at 5-foot intervals from these borings. Additional soil borings will be made for the proposed monitoring well installations. These soil samples will be used to characterize the site geology and potential transport pathways in the subsurface. Soil samples from these locations will be collected at 2.5 foot intervals to the clay aquitard and then at 5 foot intervals or each change of lithology to the total proposed depth. Head-space analyses will also be performed on these soil samples for detection of TCE contamination.

Soil samples will be collected once at each boring and well location shown on Figure 3. Samples will be obtained from a total of at least 35 locations throughout the site.

Soil samples of the granular materials encountered in the well borings will be sent to the soils laboratory for grain size distribution analysis. Results of the grain size analyses will be used in characterizing the two aquifer units. By using the Hazen formula, an approximate hydraulic conductivity value can be calculated from the grain size distribution curves.

Groundwater Samples

Groundwater samples will be collected from all existing and proposed wells at the completion of the well installations and development. This will include 11 shallow and 11 deep monitoring wells, each set providing samples from either the shallow or deep aquifer units respectively. These samples will be used to characterize the groundwater quality of each aquifer unit, identify the migration pathways, and delineate the contaminant plume(s).

During each sampling period, a groundwater level will be measured and recorded for each well. These measurements will be converted to elevations relative to a set datum (mean sea level). Prior to

collecting groundwater samples, each well will be purged of standing water within the well casing. The equivalent of approximately three casing volumes of standing water will be evacuated or the well will be bailed dry to ensure fresh groundwater sample collection. Bailing, sampling, and water level measurement equipment will be rinsed with a TSP solution and potable water before and after each use.

Groundwater samples from each well will be analyzed in the laboratory for halogenated volatile organics, specifically TCE, using USEPA methods. Samples will be collected in 40 milliliter glass vials with teflon seals and refrigerated to preserve the samples. The samples will be delivered to the analytical laboratory within 24 hours of collection

Groundwater samples will be collected from each monitoring well on a monthly basis for a period of 3 months. After the first quarter of sampling, the analytical results of the groundwater sampling will be evaluated, and if feasible, the number of sampling points reduced. Sampling of chosen wells will continue on a monthly basis for six to eight months. At the end of one year of sampling, the sampling frequency will be re-evaluated on the basis of the analytical data.

Surface Water

It is anticipated that storm water run off samples will be collected during at least one storm event during the study. Upstream and downstream samples from Nonconnah Creek will be collected at the same time. Grab samples will be made at the four locations described in Section 2.

Drinking Water

Samples of raw and finished drinking water from the Collierville Wellfield #2 will also be collected and analyzed. Intervals for this testing are still tentative but are expected to be timed to

correlate with on-site monitoring well tests (subject to approval of the well owner.)

3.6 Analytical Procedures and Quality Assurance

The Sampling Plan will specify the analytical procedures for all sample media, as well as field/laboratory quality control. With regard to the contaminant of interest, extraordinary care is required in sampling and analysis to prevent loss of the contaminant due to volatilization.

In addition methodologies which yield lowest feasible limits of detection and quantification will be required. The Quality Assurance Program will establish these requirements and set up adequate field and laboratory controls to establish that the quality assurance objectives are being met.

All sampling activities will be conducted under rigid chain of custody procedures.

3.7 Well Abandonment

At the completion of the project when groundwater monitoring is no longer required, the monitoring wells will be taken out of service. For wells completed in the upper aquifer zone, the abandonment procedure will be to remove the well casings and screens by pulling them out of the ground, using a drill rig, derrick, or crane hoist. The resulting holes will be pumped full of neat cement grout containing approximately 10 percent bentonite on a dry weight basis. The grout will be pumped into the well bore using a rigid pipe placed at the bottom of the hole.

Wells completed in the lower aquifer zone will contain both relatively large conductor casings and standard 2-inch-diameter riser pipes, both of which will be grouted into place. In consideration of these facts and the greater depth, it is unlikely

that the deeper wells can be successfully pulled out of the ground. Therefore, the abandonment procedures for the deeper wells will be to remove the steel guard pipe, then cut both riser pipe and the conductor pipe off approximately 1 foot below the ground surface. Cement/bentonite grout will then be injected at the bottom of each well until the riser pipe is completely sealed. The sealed wells may then be covered by topsoil, asphalt, or other material to complete reclamation of the well site.

All well-plugging and abandonment procedures will be supervised by a qualified geologist, experienced in well-plugging procedures. A plugging affidavit will be prepared to document the proper closure of each monitor well.

3.8 Health & Safety Plans

The Site Sampling Program will be implemented only after preparation of a detailed Site Health & Safety Plan. While a preliminary review of site data indicates that there will be no major health and safety constraints on the evaluation, the detailed site plan will address worker health and safety for each part of the study.

In particular, compliance with 29 CFR 1910.120, Occupational Safety and Health Standards for Hazardous Waste Operations and Emergency Response, will be required.

4.0 PROJECT MANAGEMENT, SCHEDULES, AND COST

The following section outlines expected project management criteria, coordination of the study with interested parties in the community, proposed project schedules, and costs.

4.1 Project Management

The single point of contact on the study has been designated by Carrier Air Conditioning Company to be:

Mr. Carl Krull
Senior Environmental Engineer
Carrier Air Conditioning Company
97 South Byhalia Rd.
Collierville, TN 38017
(901) 853-9761

All correspondence, original reports, and action requests of Carrier are to be directed to this single point of contact at the plant. Copies of reports and correspondence are to be made to:

Mr. Jess Walrath
Carrier Air Conditioning Company
Carrier Parkway
Syracuse, NY 13221
315/432-3785

Principal Project Manager for the investigation is:

Mr. Phillip G. Coop, CHMM
Vice President
Environmental & Safety Designs, Inc. (EnSafe)
P.O. Box 381315
Memphis, TN 38184
(901) 372-7962

The Project Geologists are Fred Erdmann, P.E., C.P.G., and Rich Hosfeld, C.P.G.; both of Dames & Moore. Project Engineer is Dr. James Speakman, Ph.D., P.E., of EnSafe.

Point of contact for the State of Tennessee, Department of Health and Environment, Division of Superfund, is:

Mr. Danny Brewer
Field Office Coordinator
295 Summar Avenue
Jackson, TN 38301
(901) 424-9200

4.2 Community Relations

Due to the relationship between the investigation and the interests of other organizations, copies of this study, results of tests, and final investigation reports will be coordinated with the City of Collierville, Public Works Department, via Mr. James Mathis, Director; the Memphis-Shelby County Health Department, via Ms. Helyn Keith, Manager, Pollution Control, and the Division of Solid Waste Management Field Office in Memphis via Mr. Paul Patterson, Manager.

4.3 Project Schedule

The following schedule has been prepared to show the order of investigation tasks and the relative elapsed time for each major task. The schedule assumes that TDHE, Division of Superfund reviews will require 30 days and that laboratory turn-around times will be 30 days. In the event that TDHE review and/or laboratory delivery times are extended the schedule will be adjusted accordingly. The schedule begins on Day 0, defined as the date approval of the investigation plan is received from TDHE.

In an effort to remain cost effective while still maintaining a high degree of confidence in the data generated by the study, contingency scheduling may be necessary. The sequence and schedule of field activities presented in this document will be

maintained unless the Project Manager determines that schedule alterations are required due to changes in the scope of work, uncontrollable factors such as weather or site access, or similar problems. Schedule changes will be closely coordinated with the Tennessee Division of Superfund and the Carrier Air Conditioning Company.

SITE INVESTIGATION SCHEDULE

Day 0	Notification to Proceed with investigation
Day 20	Preparation of Health & Safety Plan & final Sampling Plan
Day 25	Mobilization of Field Crew to Site
Day 55	Initial Field Work Completed. Further field work to await laboratory results.
Day 85	Laboratory results received
Day 100	Submit Revised workplan for review
Day 130	Receive Review Comments
Day 150	Mobilize Field Crews for remainder of field activities
Day 180	Field Work Completed
Day 210	Laboratory results received
Day 240	Submit Draft Report for Review
Day 270	Receive Review Comments
Day 300	Submit Final Investigation Report

Notes to Schedule:
All field work will be coordinated with the TDHE's Jackson Office to allow for state personnel to observe field activities and obtain split samples when requested. In addition sampling and analysis of installed monitoring wells will occur on an approximate monthly basis during most the project. Significant changes in this monthly monitoring data may result in delays in report preparation. Alternatively, consistency in this data may result in a recommendation to terminate monthly monitoring (with TDHE's concurrence.)

4.4 Project Costs

A detailed cost estimate is in preparation and will be finalized after review comments on the draft plan are received. At present it is anticipated that the cost of this investigation will be approximately $203,000.

5.0 REFERENCES

(1) Data on the 1979 spill has been obtained by interviewing Carrier personnel and from a review of plant files.

(2) "Report to Carrier", dated July, 1981 by Test, Inc.

(3) Data obtained from interviews with Carrier personnel.

(4) Data obtained from a review of Carrier's files.

(5) The 1985 spill investigation results are contained in two reports by Roy F. Weston, Inc., entitled Phase I and Phase II respectively.